

## Description

# [Honeycomb Catalyst Substrate Coating Chamber Seal Cleaning System]

### BACKGROUND OF INVENTION

[0001] Inflatable seals are used in industry to secure parts for processing. Where solutions are used in the processing, deposits can form on the inflatable seals, reducing the adhesion of the seal on the part, and transferring solution deposits to the part. Where the adhesion is reduced, additional pressure is required to secure the part to the inflatable seal, eventually leading to seal failure if enough pressure is applied. A typical process is catalytic converter honeycomb substrate coating. There, a solution is to be applied to the interior of a honeycomb substrate. Inflatable seals are used to secure the part in the coating system, and coating solution is passed through the interior of the honeycomb by pressure or vacuum. As the system operates, coating solution adheres to the seals. This results in insufficient sealing, which leads to coating the exterior

of the substrate, part slipping, inaccurate coating, precious metal losses, and eventual shutdown. This invention allows the operator to continuously clean the sealing surfaces while running.

## **SUMMARY OF INVENTION**

[0002] The invention described here cleans inflatable seals on-line. The current employment of the invention is in the catalytic converter coating industry, and is directly applicable to any industry where inflatable seals are used to secure parts. In this embodiment, a flat fan water spray is introduced to the seal surface in such a way as to clean deposits from the seal and wet the coating chamber, interfering with further deposits. The method used allows the operator to precisely control the quantity of water used for each cleaning cycle. In the current embodiment, water volumes of 0.1 to 3 milliliters per cleaning cycle have been accurately controlled.

## **BRIEF DESCRIPTION OF DRAWINGS**

[0003] Drawing 1 shows a general arrangement of a honeycomb catalytic converter substrate coating chamber, with the invention attached. Drawing 2 shows the mounting fixture used to secure the flat fan nozzle in the orientation re-

quired.

## **DETAILED DESCRIPTION**

[0004] This specification is directed to the invention titled: "Honeycomb Catalyst Substrate Coating Chamber Seal Cleaning System".

[0005] The current invention reveals equipment and the method to utilize it to reduce or eliminate seal deposition in coating chambers commonly used to prepare honeycomb substrate for catalytic converters. The invention uses the solvent of the coating solution, typically water, to remove and retard the formation of deposits of coating solution on seals used to secure the substrates in the dipping chamber while the system is in operation. The unique nature of the invention minimizes and in some cases avoids the effect of coating solution dilution from the cleaning system.

[0006] This embodiment includes in its simplest form a single pair of spray nozzles precisely oriented and supplied with water in such a manner that the water reflects throughout the dipping chamber, forming a film thinner than would be achieved by other means of seal cleaning. This process also minimizes the quantity of water directly entering the coating solution below the coating chamber. The thin film

of water on the dipping chamber wall adsorbs into coating solids formed as a result of water evaporation on both the chamber wall and the seals coating the prior substrate coating sequence. The dilute concentration of coating solution then is removed during the chamber purge after the subsequent part is coated. The quantity of water added to the system is below that which is normally adsorbed by the substrate during the dipping process; therefore, the invention revealed here is designed to operate throughout the coating run, typically 1000 to 20000 parts.

[0007] The benefits of this invention are readily apparent to persons skilled in automated catalyst coating. These include downtime reduction for seal cleaning, reduction or elimination of coatings on the outside of the substrate, including precious metals, consistent finished product end cap diameter for canners, and blocked cell reduction. Clean seals also provide adequate sealing for the coating chamber at lower seal pressures, resulting in less likelihood of substrate damage with thin-wall substrate.

[0008] The invention includes two high velocity fan spray nozzles mounted above the coating chamber on opposite sides, and an intermittent water supply, sequenced to alternate a single spray from each nozzle after the coated substrate is

removed from the coating chamber.

[0009] In the current embodiment, the spray volume is typically 1 ml at 40 psig, provided by a variable volume solenoid actuated diaphragm pump, directed downward at 30 degrees from horizontal in a 170 degree horizontal flat fan to a point above the top seal such that the angle of incidence reflects the spray downward and back toward the spray nozzle side, above the lower seal. The seal spray takes less than 0.5 seconds in the current embodiment, occurring after each piece is coated.

[0010] The thin film of dilute coating solution formed remains on the wall, sheeting downward if an excess of water is sprayed onto the chamber and seal. In practice, the wetted surfaces formed by the invention interfere with the nucleation sites for coating deposition, thereby eliminating further deposits from forming. It has been found that a single spray applied after every fourth coating is sufficient to keep the seals clean with most coatings.

[0011] The general operation of a typical coating chamber is detailed in US Patent 6,599,857 US class 502/300. Referring to Drawing 1, the coating chamber (6) is a cylindrical assembly designed to contain the honeycomb substrate (8) in a manner that when the substrate is lowered into the

chamber, seals (2) inflate and secure the substrate at the top and bottom. Coating solutions are then passed from the bottom through the internals of the substrate (8), the excess drained from the substrate, leaving a coating of the desired chemistry on the interior of the substrate (8). Once the coating is complete, the substrate (8) is lifted from the coating chamber (6), where a proximity sensor detects the absence of a substrate. A required overfill of the substrate results in coating solution adhering to the coating chamber above the top seal, and excess coating solution remains on the substrate as the part is removed. The coating material left in the chamber runs down over the seals, adheres to the seals, forming hard deposits in many cases, and always forms concentrated solutions, which are then transferred to the next substrate processed. Coating losses can be as high as 2% in some cases, with the material adhering to the outside of the substrate. Since at least part of the coating is precious metal, these losses are significant. If the process is allowed to continue untreated, deposits will increase to the point where system shutdown is required.

[0012] At the moment that the substrate is removed from the chamber, the seal cleaning system, the invention dis-

closed here, operates. The controller (11) first signals (5) one of the solenoid valves (7) to open, and then signals (5) the solenoid actuated diaphragm pump (4) to produce a single pulse of water from the storage vessel (10) to one of the spray nozzles (1). All of the transfer piping (3) is a semi-rigid pipe or tube completely filled with water. After the first pulse is complete, the controller (11) signals the first solenoid valve (7) to close, and the second to open. At that time, the controller (11) again signals the solenoid actuated diaphragm pump (4) to pulse to the second spray nozzle (1). The spray operation generally takes less than 0.5 seconds. The process is repeated as necessary to maintain clean seals, and can be operated after every piece, or intermittently. Operation using solenoid valves directly connected to a pressurized water line is anticipated, though the described embodiment is preferred due to the precise control of feed rate.

[0013] Drawing 2 shows a larger view of the spray nozzle block (1), and is comprised of a flat fan spray nozzle (12), and a machined block which controls the spray angle and allows the connection to the supply line to be horizontal. The horizontal inlet reduces the possibility of the nozzle self-draining, while not requiring the use of a check valve. The

fan spray nozzle in this case is threaded for maintenance.  
The machined block is attached in any way to the chamber.